Nuclear Instruments and Methods in Physics Research B49 (1990) xi–xvii
North-Holland

CONTENTS

Editorial vii
Conference photograph viii
Committees x

Section I. X-ray production

K and L shell cross sections for use in PIXE analysis systems
Cohen, D.D. 1
K X-ray production from rare earths by high energy protons
Peisach, M. and C.A. Pineda 10
Intensity analysis of F Kα satellite spectra of NaF and KF
Tachibana, M., H. Adachi, T. Mukoyama, Y. Hibino, Y. Sasa, K. Fuwa and M. Uda . 15
M-shell X-ray production in heavy elements by low-energy protons
Bieńkowski, A., J. Braziewicz, T. Czyżewski, L. Głowacka, M. Jaskóla, G. Lapicki and M. Pajek 19
Intense sources of monochromatic X-rays for XRF analysis from cyclotron beams
Avaldi, L., S. Bassi, M. Milazzo and M. Silari 24
Deuteron excitation as an alternative in PIXE analysis
Romo-Kröger, C.M. 29

Section II. Experimental arrangements – sample preparation, combined techniques

A complementary technique to PIXE: the nuclear interaction analysis method – advantages, possibilities and typical application examples
Engelmann, Ch. 33
Experimental arrangements for the simultaneous use of PIXE and complementary accelerator based techniques
Räisänen, J. 39
Complementarity of RBS, PIGE and PIXE for the determination of surface layers of thicknesses up to 30 microns
Demortier, G., S. Mathot and B. Van Oystaeyen 46
Mass loss during X-ray microanalysis
Themner, K., P. Spanne and K.W. Jones 52
Sample preparation methods of tree-rings for PIXE–PIGE multielemental analysis
Hall, G.S. 60
Selective filtering in PIXE spectrometry
Swann, C.P. and S.J. Fleming 65
The ^{7}Li(p, α)^{4}He reaction for thin target monitoring
Pallon, J. and P. Kristiansson 70
The influence of sample roughness on the quantification of micro-PIXE results
Orlić, I., F. Van Langevelde and R.D. Vis 74

0168-583X/90/$03.50 © Elsevier Science Publishers B.V.
(North-Holland)

A new PIXE chamber for highly reproducible and automatized operation
Wätjen, U., H. Prins, R. Van Bijlen and E. Louwerix 78

A PIXE system for commercial applications
Li, H.-K. 85

EUTERPE, a small electron storage ring for XRF
Botman, J.I.M., P.H.A. Mutsaers, H.L. Hagedoorn and M.J.A. De Voigt 89

An investigation of laser desorption by PIXE and RBS techniques
Brissaud, I., P. Belanger, J.E. Crawford, H. Dautet, G. Gagnon, A. Houdayer, J.K.P. Lee, J. Obert, J. Pinard and K. Scholberg 94

A new technique for quantifying light elements in thin samples
Kristiansson, P. and E. Swietlicki 98

Simultaneous PIXE–PIGE analysis of thin and thick samples
Boni, C., A. Caridi, E. Cereda, G.M. Braga Marcazzan and P. Redaelli 106

Applications of the concentration depth profiling with PIXE
Jakšić, M., M. Vajić and V. Valković 111

Section III. Detection of X-rays, detector response, data handling

X-ray spectrometers for PIXE
Campbell, J.L. 115

High-resolution X-ray spectrometer for PIXE work
Folkmann, F. and F. Frederiksen 126

Application of the EVE deconvolution method to the analysis of PIXE spectra
Tapper, U. and P. Paatero 132

Thick target yields for determination of thin target PIXE efficiency
Budnar, M., Ž. Šmit and P. Kump 138

Proton induced X-ray emission of spherical particles: corrections for X-ray attenuation
Jex, D.G., M.W. Hill and N.F. Mangelson 141

SPECTRE: a program for ultra trace PIXE analysis of thin targets
Cecchi, R., M.G. Ferrari, G. Ghermandi and M. Rossi 146

A set of X-ray fluorescence reference sources for the intrinsic efficiency calibration of Si(Li) detectors down to 1 keV
Denecke, B., W. Bambynek, G. Grosse, U. Wätjen and C. Ballaux 152

Elemental concentrations from proton induced thick target X-ray yields
Šmit, Ž., M. Budnar, V. Cindro, P. Kump, V. Ramšak and M. Ravnikar 157

Weighting measures in fitting PIXE spectra
Clayton, E. and C.G. Ryan 161

TTPIXAN – A package of computer programs for quantitative thick target PIXE analysis
Orlić, I., J. Makjanić, G.H.J. Tros and R.D. Vis 166

WITS-HEX: a renovated code for analysis of PIXE X-ray spectra
Lipworth, A.D., H.J. Annegarn, S. Bauman, T. Molokomme and A.J. Walker 173

Automation in PIXE data acquisition
Johnson, J.E., R.H. Leonard, S. Bauman, H.J. Annegarn and J.W. Nelson 179

Section IV. Biological applications of PIXE

Quantitative PIXE analysis of biomedical material – Sample preparation, irradiation and quality control
Malmqvist, K.G. 183

Brain trace element alterations in atherosclerosis
Pinheiro, T., J.M. Halpern, R. Fernandes, S. Ramos, S. Silva, H. Duflou, J. Cafmeyer and W. Maenhaut 191

Microelemental measurement of tomato plants by using PIXE and ICP methods
Takács, S., F. Ditrói, M. Pankotai and P. Fodor 195

Trace element analysis by PIXE in liver samples from dogs with chronic active hepatitis and liver cirrhosis
Andersson, M., A.-K. Ekholm and E. Sevelius 198

Use of PIXE to measure serum copper, zinc, selenium, and bromine in patients with hematologic malignancies
Beguin, Y., V. Bours, J.-M. Delbrouck, G. Robaye, I. Roelandts, G. Fillet and G. Weber 202

PIXE–PIGE analysis of teeth from children with and without cystic fibrosis
Cua, F.T. 205

Diffusion of metals from crown into teeth
Tadić, T., M. Jakšić, J. Babić-Živko, J. Čiček, S. Fanzinić and V. Valković 211

Combined PIXE/RBS study on the incorporation and depth distribution of cesium in cuticles of pear leaves subject to cation exchange in a CsCl solution
Hietel, B., J. Ertel and K. Wittmaack 216

Trace elements in tissues and organs of an antarctic icefish, Champsocephalus gunnari
Ishikawa, M. and K. Nakamura 220

PIXE analysis of toxic mussels
McKee, J.S.C., D. Gallop, M.S. Mathur, A.A. Mirzai, Y.H. Yeo, C. Pinsky and R. Bose 225

PIXE analysis of human spermatozoa isolated from seminal plasma
Maeda, K., Y. Sasa, H. Kusuyama, K. Yoshida and M. Uda 228

PIXE analysis of elements in gastric cancer and adjacent mucosa
Liu Qixin, Zhong Ming, Zhang Xiaofeng, Yan Lingnuo, Xu Yongling and Ye Simao . 231

Trace element relations to renal stones phases
Paluszkiewicz, C., W.M. Kwiatek and M. Gałka 234

Evaluation of the extracellular water in human body by determination of Br concentration in blood plasma
Shao, H.R., Q.X. Liu, G. Enzi, G. Moschini and G. Sergi 238

PIXE analysis of preconcentrated body fluids, especially urine
Pakarinen, P., A.-K. Ekholm and J. Pallon 241

Elemental analysis of long bones of infants from Ficana excavations
Tapper, U., H. Vuorinen and H. Mussalo-Rauhamaa 245

Trace elements in human alveolar macrophages studied by PIXE
Weber, G., I. Roelandts, J.L. Corhay, M. Radermecker and J.P. Delavignette 250

The effect of radiotherapeutic irradiation on the elemental concentration of iron in human erythrocytes and blood plasma
Borbély-Kiss, I., E. Koltay, Gy. Szabó, É. Pintye, E. Groska and A. Kiss 254

Analysis of trace element content in tree cores by PIXE
Pernestål, K., H.-K. Li and B. Jonsson 261

Section V. Geological and archaeological applications of PIXE

Geological and mineralogical applications of PIXE: a review
Annegarn, H.J. and S. Bauman 264

Quantitative analysis of PIXE spectra in geoscience applications
Ryan, C.G., D.R. Cousens, S.H. Sie and W.L. Griffin 271
Analysis of volcanic samples by α parameter method established for correcting PIXE measurements
Aloupogiannis, P., J.P. Toutain, G. Robaye, I. Roelandts, J.P. Quisefit and G. Weber . 277
PIXE analysis to study metal diffusion and sedimentation phenomena in Venice Lagoon
Cecchi, R., G. Ghermandi and R. Zonta 283
PIXE at the Louvre Museum
Kusko, B.H., M. Menu, T. Calligaro and J. Salomon 288
Characterization of ancient materials using PIXE spectrometry
Fleming, S.J., C.P. Swann, P.E. McGovern and L. Horne 293
Nonvacuum analyses of silver coins (9th to 15th century A.D.)
Meyer, M.-A. and G. Demortier 300
Analysis of Gaulish coins by proton induced X-ray emission, synchrotron radiation X-ray fluorescence and neutron activation analysis
Brissaud, I., P. Chevallier, C. Dardenne, N. Deschamps, J.P. Frontier, K. Gruel, A. Taccoen, A. Tarrats and J.X. Wang 305
Thick target PIXE analysis of coastal and inland Namibian pottery
Peisach, M., C.A. Pineda and L. Jacobson 309
Leaf analysis as an exploratory tool in mineralogy
Mirzai, A.A., J.S.C. McKee, Y.H. Yeo, D. Gallop and J. Medved 313
Application of the proton microprobe to diamond exploration and genesis
Griffin, W.L., C.G. Ryan, D.R. Cousens, S.H. Sie and G.F. Suter 318
Correlations between chemical composition as determined by PIXE and the paramagnetism of auriferous vein quartz
Van Moort, J.C., D.D. Cohen, D.W. Russel and A. Katsaros 323
Elemental analysis of sediments from the Severn Estuary
Sokhi, R.S., A. Davis, K. Randle, J.R. West and M.S. West 328
Cation-ratio differences in rock patina on hornfels and chalcedony using thick target PIXE
Pineda, C.A., M. Peisach, L. Jacobson and C.G. Sampson 332
Studies of trace element distribution at the coal–rock interface
Vajić, M., M. Jakšić, S. Fazinić, V. Valković, G.W. Grime and F. Watt 336
Hydrogen microdetermination in geological materials using elastic recoil detection analysis (ERDA)
Mosbah, M., J. Tirira, R. Clocchiatti, J. Gosset and P. Massiot 340

Section VI. Aerosol studies with PIXE

Analysis of air pollutants by PIXE: the second decade
Cahill, T.A. 345
An intercomparison of PIXE and XRF for statistically resolving aerosol components in Leningrad and environs
Winchester, J.W., V.A. Ivanov, M.A. Prokofyev, D.A. Zhukovski, A. Shlikhta, V.F. Zhvalev, A.N. Zhukovski, D.M. Stroganov, J.W. Nelson, S.E. Bauman and L.N. Nakhgaltsev 351
On the status of preparing an aerosol filter reference material for elemental analysis
Wätjen, U., W. Dannecker and M. Kriews 360

Trace element concentrations and size distribution of biogenic aerosols for the Amazon Basin during the wet season
Artaxo, P. and W. Maenhaut 366
Source profiles by unique ratios (SPUR) analysis: interpretation of time-sequence PIXE aerosol data
Annegarn, H.J., A. Zucchiatti, E. Cereda and G.M. Braga-Marcazzan 372
PIXE analysis of size-fractionated aerosol samples collected at Birkenes, Norway, during spring 1987
Cornille, P., W. Maenhaut and J.M. Pacyna 376
Trace elements and receptor modelling of aerosols in the Antarctic Peninsula
Artaxo, P., F. Andrade and W. Maenhaut 383
An evaluation of elemental concentrations in atmospheric aerosols over Hungary: regional signatures and long-range transport modelling
Borbély-Kiss, I., E. Koltay, Gy. Szabó, L. Bozó, E. Mészáros and Á. Molnár 388
A new PIXE setup dedicated to the analysis of aerosol samples
Swietlicki, E., H.-C. Hansson and N.E.G. Lövestam 395
Source identification of a pollution incident by high time resolution measurements of air particulates
MacArthur, J.D., P.J. Harvey, D.J. Lamb, X.-P. Ma and G.R. Palmer 402
Study of respirable immission levels for a cyclist in Brussels' traffic using PIXE as analytical technique
Maenhaut, W., L. Thiessen and G. Verduyn 406
PIXE analysis of carbon black for elemental impurities
Sokhi, R.S., C. Gray, K. Gardiner and L.G. Earwaker 414

Section VII. Microprobe techniques and instrumentation

Microprobe techniques and instrumentation
Legge, G.J.F. and A. Saint 418
The Lund nuclear microprobe: instrumentation, data collection and data evaluation
Tapper, U.A.S., R. Hellborg, M.B. Hult, N.P.-O. Larsson, N.E.G. Lövestam, K.G. Malmqvist, J. Pallon and K. Themner 425
Commissioning and characterization of the Manitoba automated high energy proton microprobe
Yeo, Y.H., J.S.C. McKee, G.R. Smith, K. Abdul-Retha, J.J.G. Durocher, D. Galop, W. Mulholland and C.A. Smith 430
Advantages of high speed scanning for microprobe analysis of biological samples
Llabador, Y., D. Bertault, J.C. Gouillaud and Ph. Moretto 435
Micro-PIXE quantification on histochemical reactions
Rokita, E., T. Cichocki, S. Divoux, B. Gonsior, M. Höfert, L. Jarczyk, A. Strzalkowski and M. Sych 441
A proton miniprobe for mineralogy
Zine, E., D.B. Isabelle and G. Rémond 446

Section VIII. Microprobe applications

Micron and submicron nuclear probes in biomedicine
Lindh, U. 451

Nuclear microscopy of the algae *pandorina morum* (müll.) bory
Watt, F., A.J. Brook and G.W. Grime 465
Technical aspects of nuclear microprobe analysis of senile plaques from Alzheimer patients
Larsson, N.P.-O., U.A.S. Tapper, K. Sturesson, R. Odselius and A. Brun 472
The effect of fluoride on mineralization during tooth germ development in neonatal hamsters
Tros, G.H.J., D.M. Lyaruu and R.D. Vis 476
A contribution to the study of biogeochemical cycling in an English lake by PIXE: the flux of barium and strontium inm the phytoplankton
Brook, A.J., F. Watt and G. Grime 481
PIXE scanning analysis across the scale of a sea-bass, *lateolabrax japonicus*
Ishikawa, M., T. Ishii and K. Kitao 485
Scanning proton microprobe analysis applied to wood and bark samples
Lövestam, N.E.G., E.-M. Johansson, S.A.E. Johansson and J. Pallon 490
The Hamburg proton microprobe: application in environmental analysis
Grossmann, D., J.P. Koopmann, M. Niecke, J. Schöttler and R. Khorasani 495
PIXE microprobe studies of gold–cadmium alloys processed by local diffusion
Decroupet, D. and G. Demortier 501
Diffusion of silicon in polycrystalline gold foils observed with a PIXE microprobe
Mathot, S. and G. Demortier 505
Micro-PIXE analyses of carbonate minerals from the lower Zechstein Kupferschiefer Formation (Poland)
Przybyłowicz, W., A. Piestrzynski, K. Traxel and S. Bajt 509
Measurement of carbon in ordinary chondrites with a nuclear microprobe
Makjanić, J., D. Heymann and R.D. Vis 514

Section IX. Comparison with other analytical techniques; synchrotron radiation; miscellaneous applications

Recent advances in nuclear and atomic spectrometric techniques for trace element analysis. A new look at the position of PIXE
Maenhaut, W. 518
The uses of synchrotron radiation sources for elemental and chemical microanalysis
Chen, J.R., E.C.T. Chao, J.A. Minkin, J.M. Back, K.W. Jones, M.L. Rivers and S.R. Sutton 533
The synchrotron radiation microprobe at the SRS, Daresbury (UK) and its applications
Van Langevelde, F., G.H.J. Tros, D.K. Bowen and R.D. Vis 544
Quantitative analysis by synchrotron radiation induced X-ray fluorescence at LURE
Chevallier, P., I. Brissaud and J.X. Wang 551
X-ray microanalysis with energy tunable synchrotron X-rays
Hayakawa, S., Y. Gohshi, A. Iida, S. Aoki and M. Ishikawa 555
Trace element distribution in the rat cerebellum
Kwiatek, W.M., G.J. Long, J.G. Pounds, K.R. Reuhl, A.L. Hanson and K.W. Jones .. 561
PIXE induced XRF analysis of trace amounts of iron in pure copper matrix
Quynh, L.H., I. Demeter and Z. Szökefalvi-Nagy 566
Application of PIXE analysis to materials science
Sasa, Y., K. Maeda and M. Uda 569

Applications of PIXE–PIGE in philately
Hall, G.S. and M.L. Lee 573

Conference summary
Johansson, S.A.E. 577

Author Index 581